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Winter Storm 2005
Bolivar, Ohio and Vicinity

Huntington District

US Army Corps of Engineers

March 8, 2005

Agenda

- Muskingum reservoir system
- January 2005 winter storm
- Impacts
- Reservoir Operations
- Dam safety issues
- Engineering response
- Future plans
- Questions

Flood Damage Reduction Mission

- Protect human life, property and environment by:
  - Communicating with community
  - Minimizing flooding
  - Safely operating dams
  - Monitoring and surveillance
  - Making necessary repairs

Muskingum River Basin

- Model flood system for the nation

Drainage area (sq. mi.)

Controlled area	=	5,018
Uncontrolled area	=	3,033
Total area	=	8,051

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Muskingum Watershed

- Flood of 1913
- Muskingum Watershed Conservancy District (MWCD)
- Official plan (1934)
- Fourteen original dams (1934 - 1938)
- 1939 projects included in comprehensive Ohio River Flood Control Plan
- Benefits

Development of Reservoirs

- March 1913
  - Flood of record in Tuscarawas Basin
  - Significant flooding in New Philadelphia and Dover
    - If reservoirs had existed, flooding would have been minor
  - Nearly 6.5 inches of rain fell over 5 days
  - $14 million in damage in Muskingum Basin communities
- Primary purpose to reduce downstream flooding along Tuscarawas, Muskingum, and Ohio rivers

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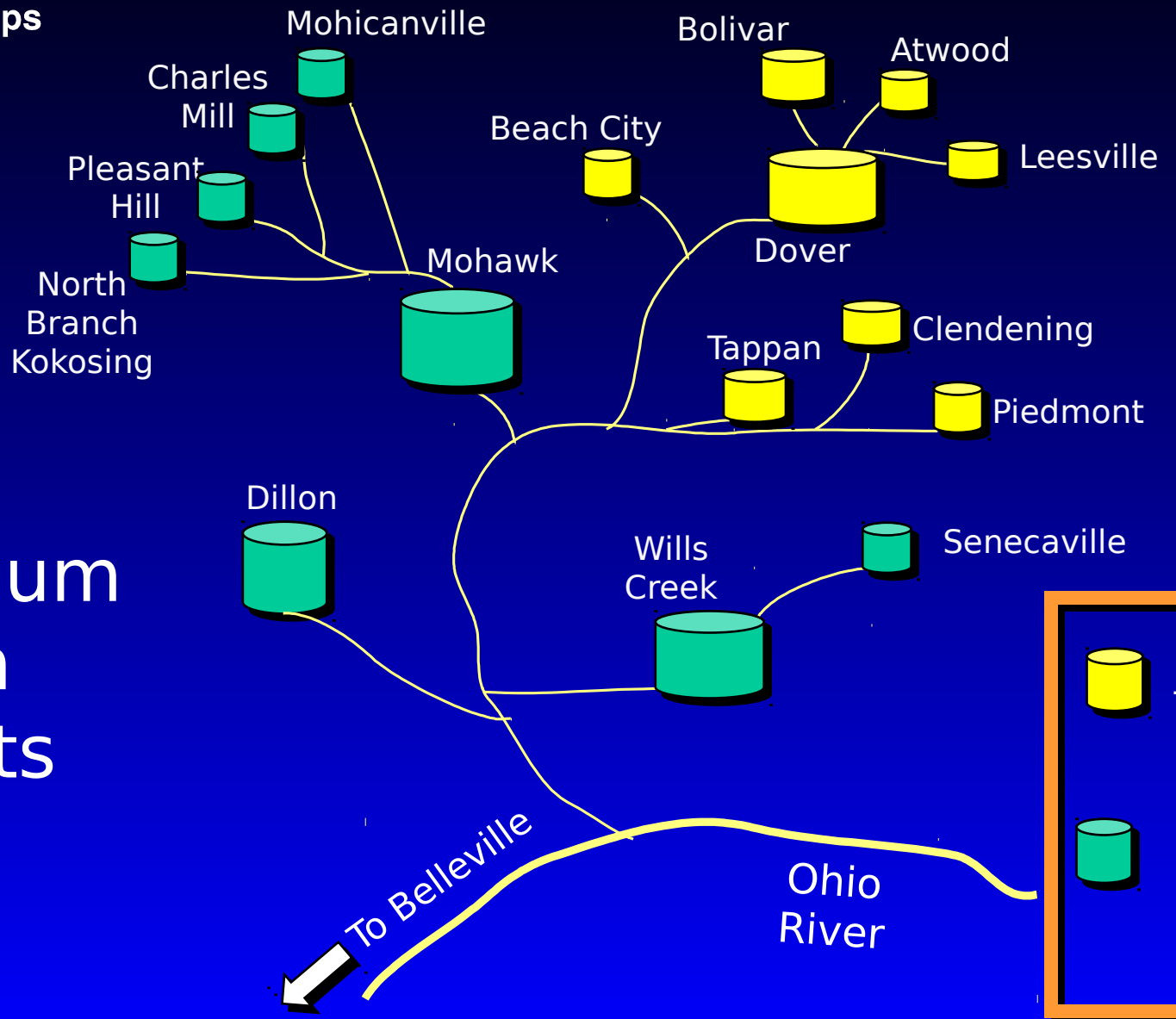
Muskingum Basin Projects



Winter Storm 2005

- Four weather events resulted in major flooding
  - 23-24 Dec, 1-2 inches rainfall and 4 inches snowfall
  - 3-8 Jan, 4 inches rainfall
  - 12 Jan, 1-2 inch rainfall
  - 14 Jan, up to ¾ inch rainfall
- 7 projects reached pools of record
- Wills Creek exceeded spillway elevation

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Winter Storm 2005

Lake	***Previous Pool of Record***	***Date of Previous Pool***	***New Pool of Record***	***Feet above Normal***
Atwood	934.53	Feb 52	935.14	12.1
Bolivar	950.14	Jan 91	951.65	56.6
Dover	905.00	Jul 69	907.35	49.4
Charles Mill	1013.53	Jan 59	1017.10	25.1
Dillon	772.89	Mar 64	788.23	54.2
Mohawk	873.94	Jan 59	880.20	80.2
Wills Creek	776.73	Mar 64	779.36	37.4

Winter Storm 2005 Impacts

- Pools of record
  - Inundated roads above Dover, Bolivar, Beach City, and Atwood
    - Isolation and Evacuation
    - Closure of Schools and Businesses
  - Industry impacted due to Beach City Rail closure

Winter Storm 2005 Impacts

- Downstream
  - Dover
    - First floor damage to homes along river
    - River flooding in basement/crawlspace
    - Groundwater basement flooding
  - Beach City
    - Groundwater basement flooding along Sugar Creek

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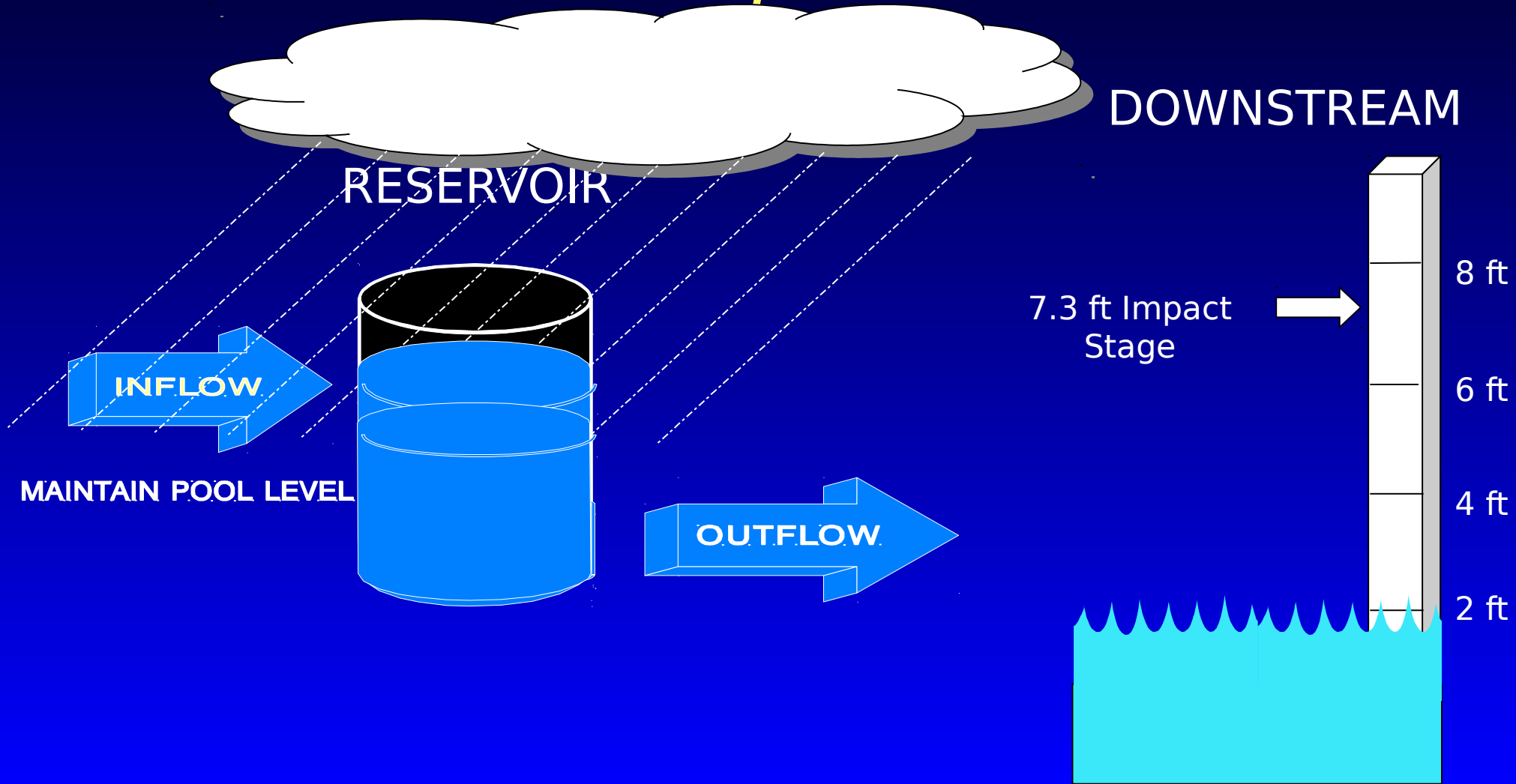
Normal Reservoir Operations



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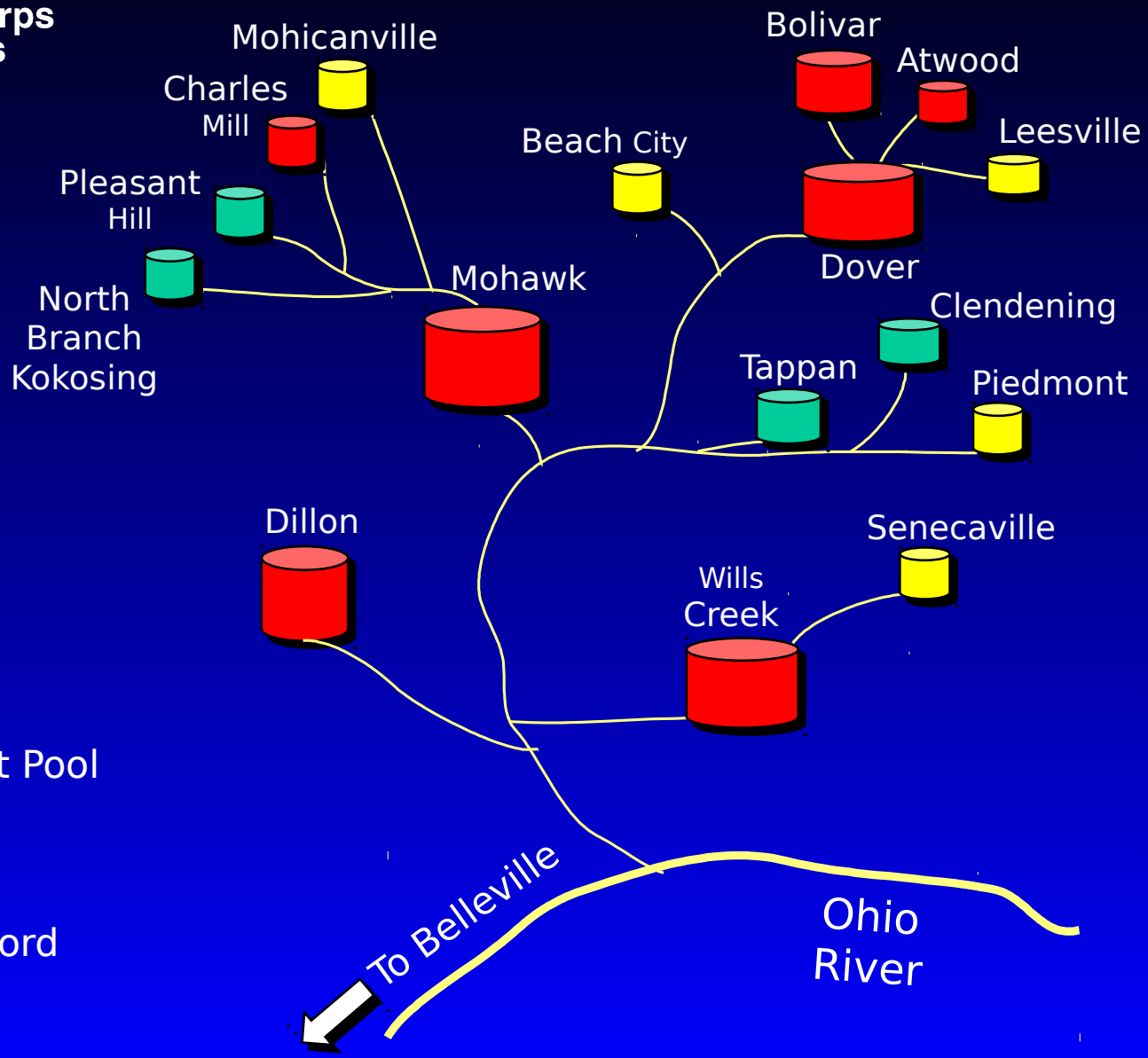
Muskingum Peak Storage



= Below Alert Pool

= Alert Pool

= Pool of Record

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January 2005 Flood Probability at Reservoirs

	as observed
Dover	72 year
Bolivar	56 year
Beach City	68 year
Atwood	60 year

January 2005 Flood Probability at Downstream Gage Locations

	without reservoir	as observed
New Philadelphia	70 year	500+ year
Uhrichsville	20 year	500+ year
Newcomerstown	10 year	500+ year
Coshocton	11 year	375 year

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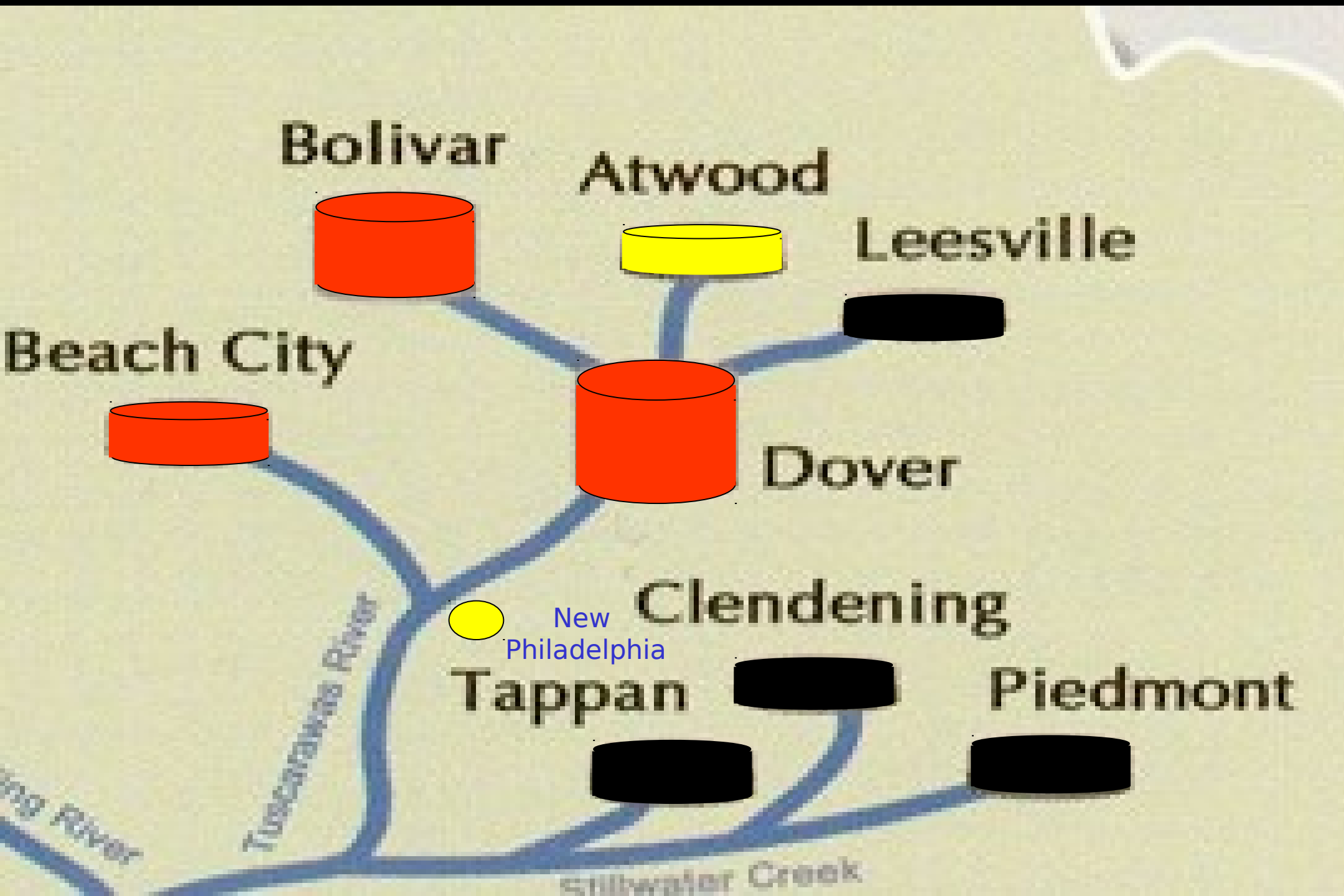
January 2005 Flood Reductions at Downstream Gage Locations

	Impact Stage (feet)	Without Observed (feet)	Reservoirs (feet)	Reduction
New Philadelphia	7.3	8.4	12.9	**4.5**
Uhrichsville	5.0	8.9	19.4	**10.5**
Newcomerstown	11.0	10.3	17.7	**7.4**
Coshocton	18.0	19.5	28.8	**9.3**
Marietta	35.0	41.0	50.5	**9.5**

How safe are the dams?


Bolivar
Atwood
Leesville
Beach City
Dover
Clendening
New Philadelphia
Tappan
Piedmont
Tuscarawas River
Stillwater Creek

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Dam Safety Team

- Operations staff
  - 35 on site
  - 14 supplemental
- Deployment of engineer team
  - 14 professionals
  - Regional experts
- Construction contractors
- District & regional offices

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Inspections/Instrumentation

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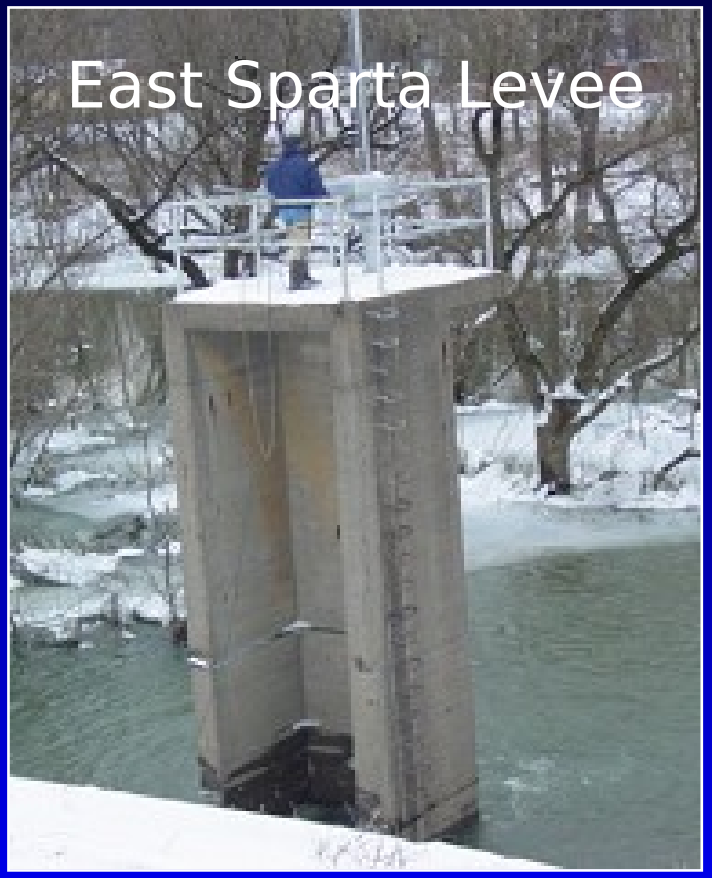
Operations



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Constructing Repairs

Beach City Dam, within 1 inch Pool of Record

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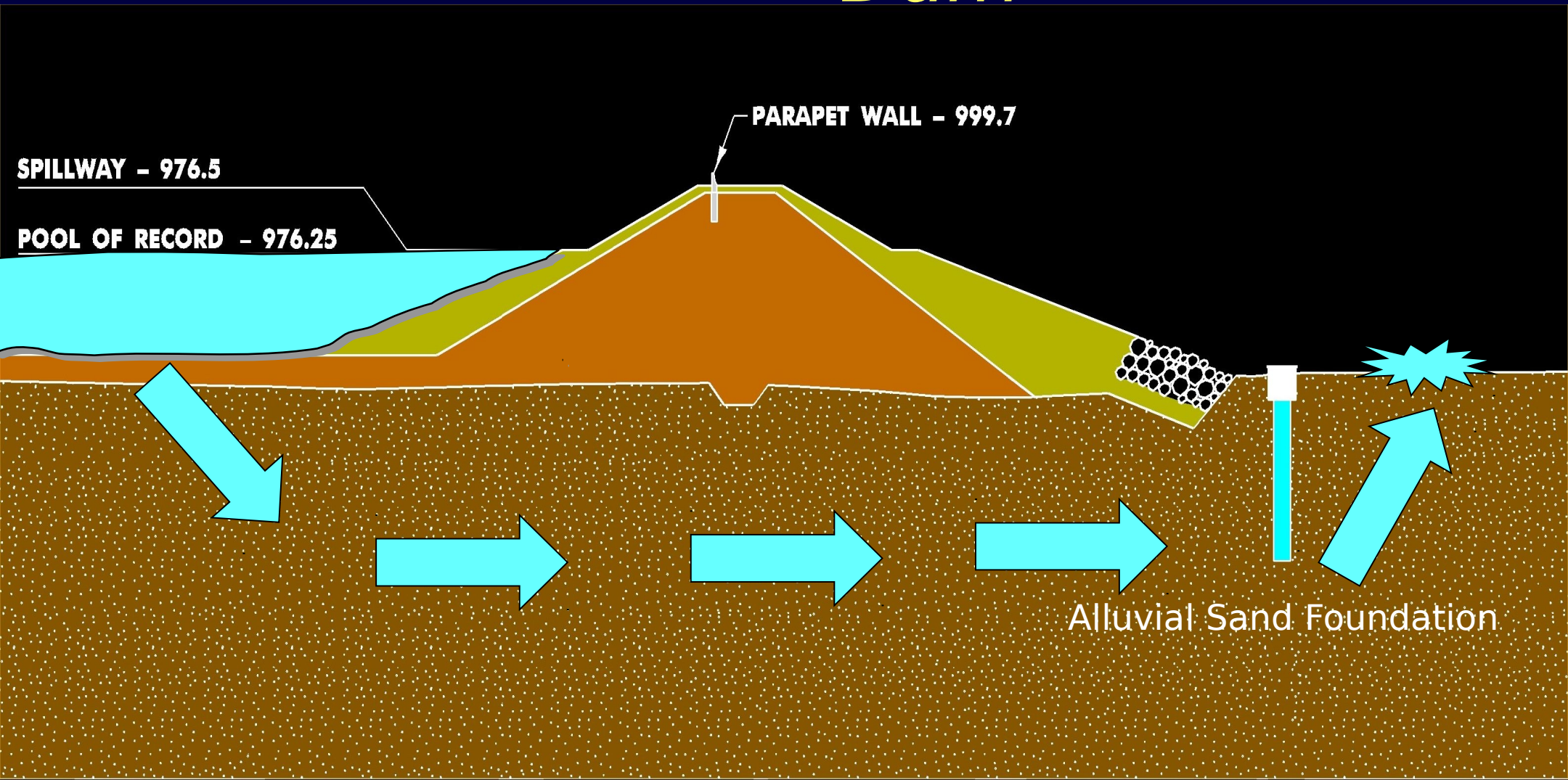
Cross Section – Beach City Dam



Beach City Dam, Downstream Toe and Relief Well System

Beach City Dam, Relief Well Flow

Beach City Dam, Sand Bag Ring on Boil

Beach City Dam, Filter Blanket Construction

Bolivar Dam, Pool of Record

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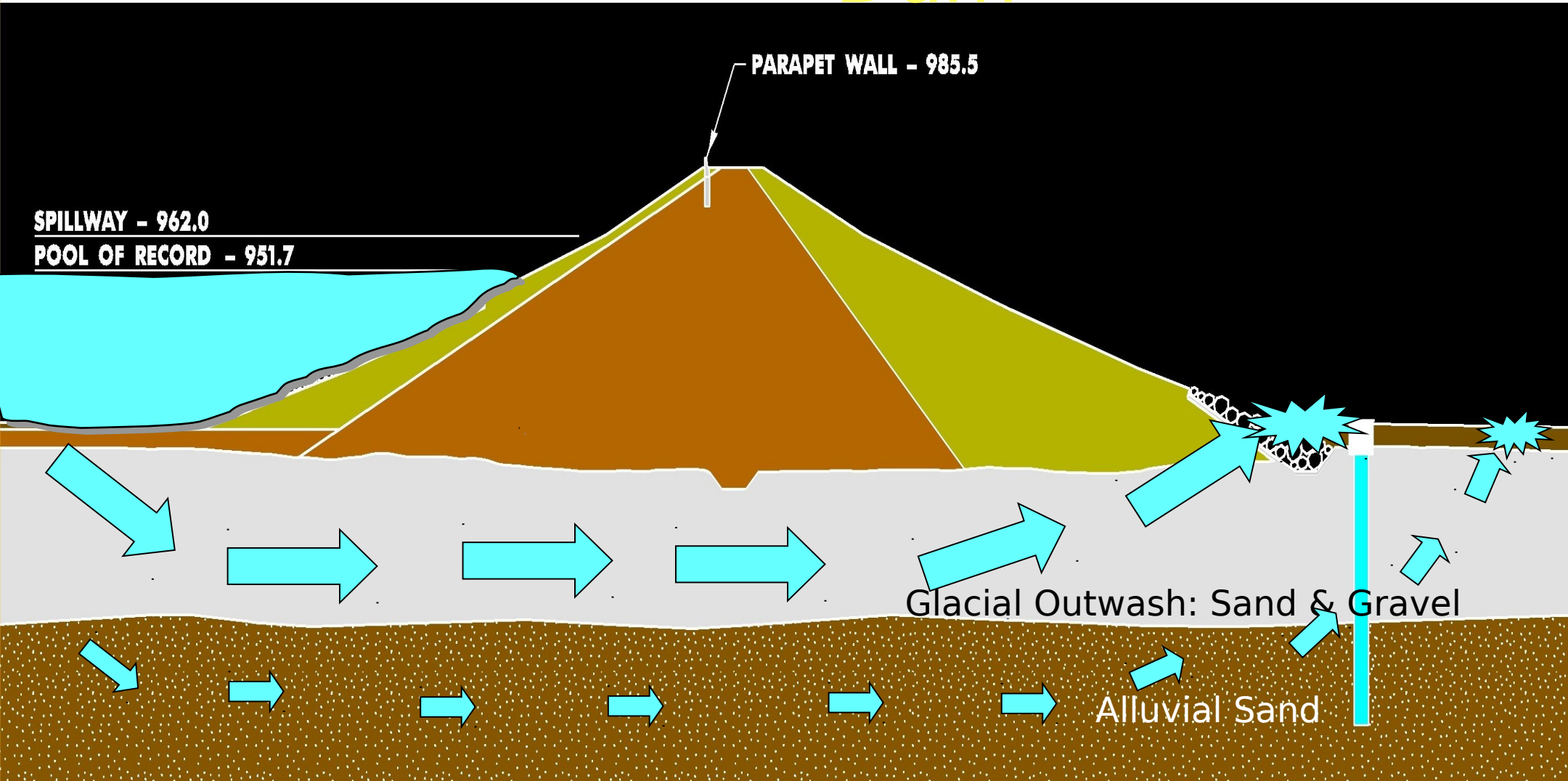
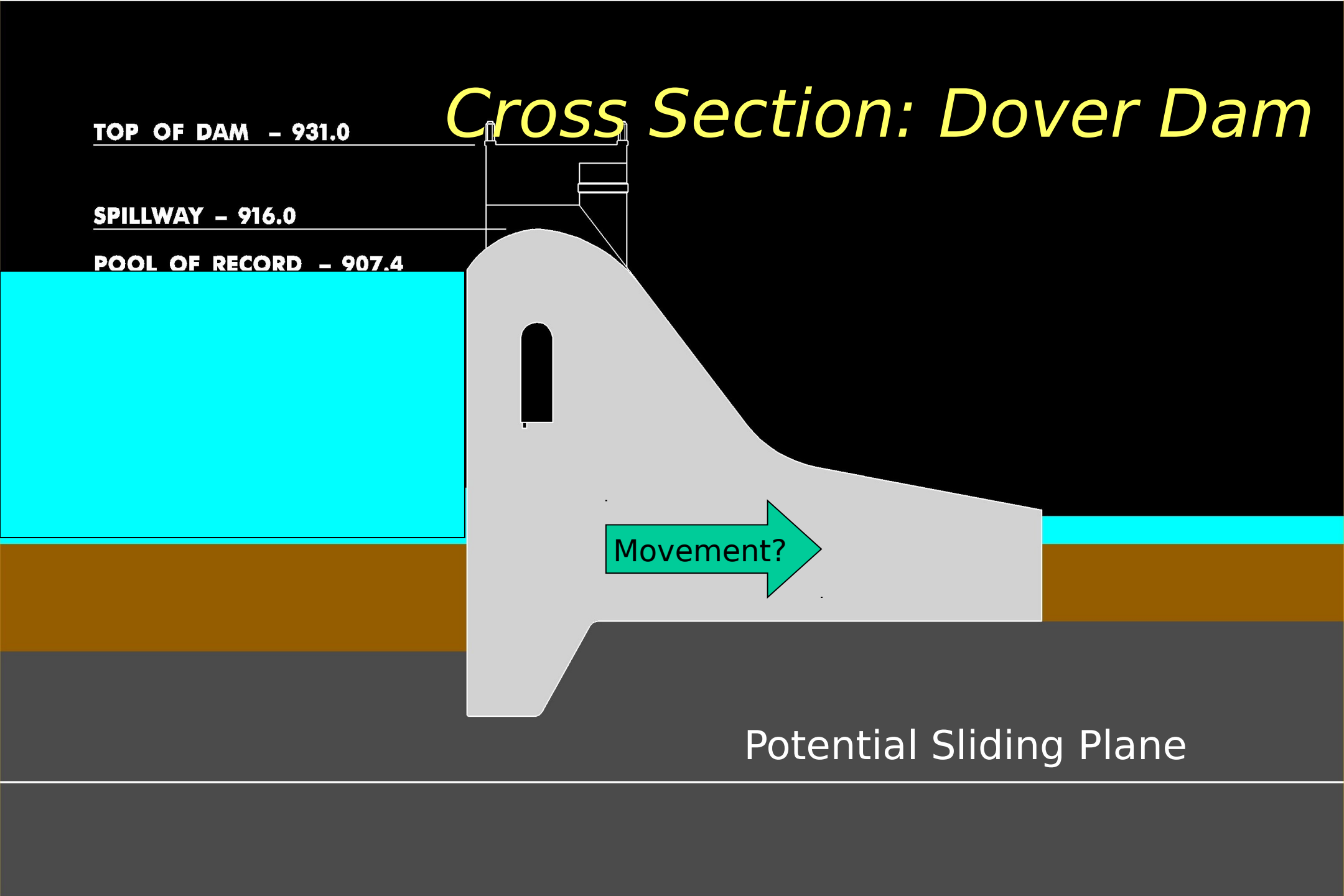
Cross Section: Bolivar Dam



Terrace and Filter Blanket Area
at Bolivar, High Dover Tail Water

Terrace Seepage at Bolivar, Post Repair

Dover Dam, Pool of Record

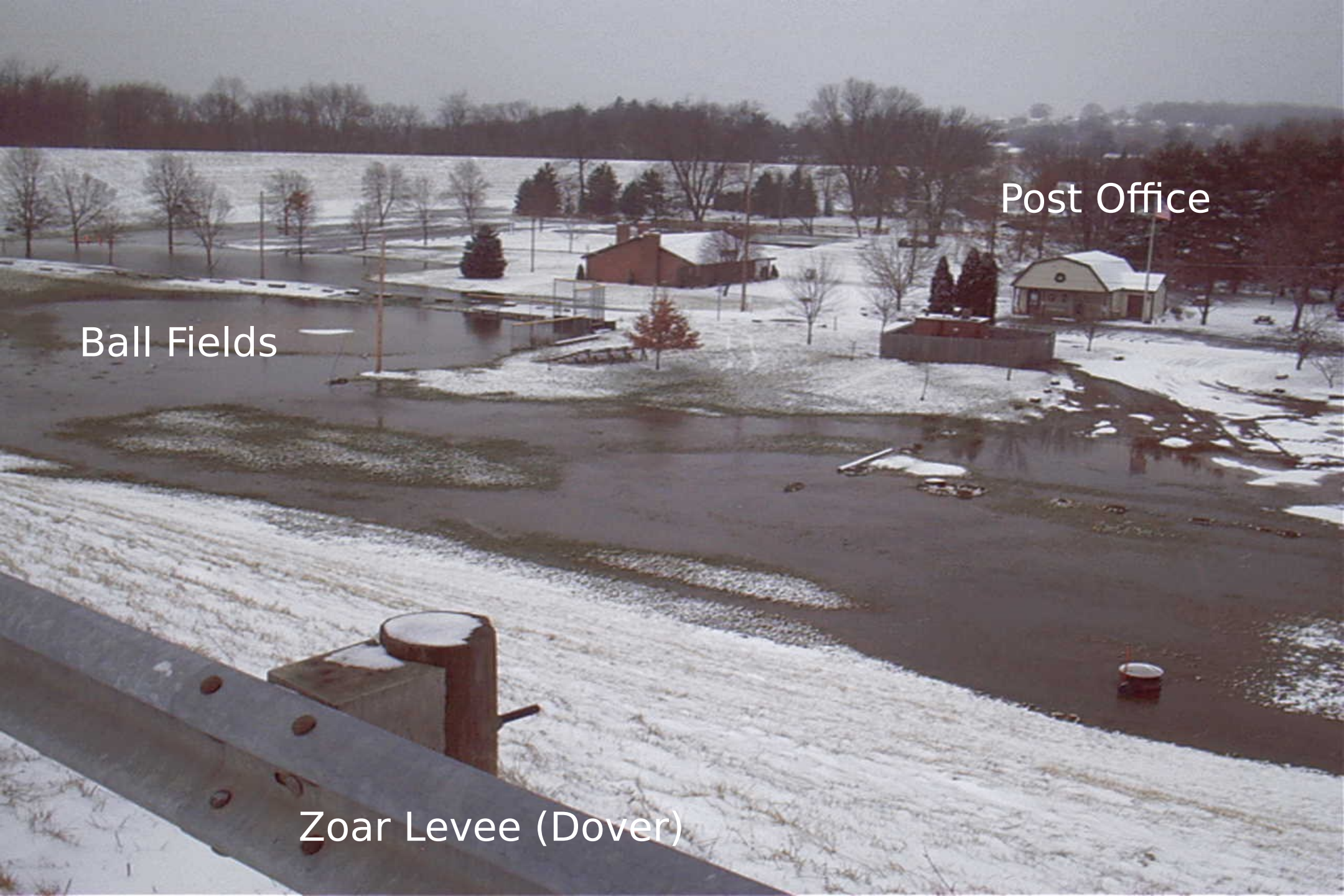

Cross Section: Dover Dam
TOP OF DAM – 931.0
SPILLWAY – 916.0
POOL OF RECORD – 907.4
Movement?
Potential Sliding Plane

Dover Dam, Crack and Seepage Monitoring

Dover Dam, Foundation Drain Cleaning

Magnolia Levee (Bolivar Reservoir)

Village of Zoar, Zoar Levee (Dover)


Post Office
Ball Fields
Zoar Levee (Dover)

Zoar Levee (Dover), Seepage at Ball Fields

Summary

- Dam safety concerns validated by storm!
- Actions successful in mitigating risks
- Dams are old, but well constructed and performed satisfactorily

The Path Forward...

- Interim actions
  - Reservoir management
  - Interim repairs
- Emergency management
- Permanent repairs
  - Individual dams
  - Basin wide approach

Interim Actions

- Reservoir management policies:
  - Continue to operate local projects as part of reservoir system to minimize downstream flooding
  - Mitigate seepage and stability concerns by managing reservoirs
    - Bolivar
    - Beach City
    - Dover

Interim Actions

- Interim repairs constructed at:
  - Bolivar: partial repair completed
  - Dover: foundation drains cleaned
  - Beach City: partial repair completed

Permanent Repairs

- Bolivar Dam:
  - Second year of investigation and design
  - Highest dam safety priority in region
  - Construction anticipated 2009
- Dover Dam:
  - Second year of investigation and design
  - Fourth highest dam safety priority in region
  - Construction anticipated 2009

Permanent Repairs

- Beach City Dam and Zoar Levee:
  - Significant regional priorities

Permanent Repairs

- Muskingum River Basin initiative
  - Comprehensive call for renewal of all flood protection, water management, eco system and recreation infrastructure in the basin
  - Partnership with Muskingum Watershed Conservancy District, U.S. Geological Survey, National Resource Conservation Service, Ohio Department of National Resources, U.S. Fish & Wildlife, and others
  - Master plan being developed

Additional Information

- Web sites:
  - Corps of Engineers
    - http://www.lrh-wc.usace.army.mil/wc/musns.htm
  - National Weather Service
    - http://www.nws.noaa.gov
    - http://www.erh.noaa.gov/er/ohrfc
  - Muskingum Watershed Conservancy District
    - http://www.mwcdlakes.com
  - Muskingum River Basin Initiative
    - http://www.muskingumbasin.org

Questions

- Corps of Engineers:
  - Colonel Bulen
  - Eric Halpin – Dam Safety
  - Dave Meadows – Water Management
  - Nick Krupa – Muskingum Area Office
  - Carl Miller – Emergency Management
- John Hoopingarner - MWCD
- Jeff Bonomo – ODOT
- Patty Levengood – County EMA
- Joe Bachman – County Engineer
- County Commissioners